

The effects of cravings on metacognition

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Statement of Sources

I declare that this report is my own original work and that contributions of others
have been duly acknowledged.

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Date: _____

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Abstract

This study used a sample ($N = 68$) of regular coffee drinkers to investigate how cravings may influence JOLs when completing a cue-only word pair task. Two groups: a craving and a control group were randomly allocated where cravers had to avoid consuming coffee before testing. Both groups completed a word pair encoding task followed by completing either a craving induction task if they had abstained from coffee or a control task if they had not. Both groups then made cue-only JOLs and a subsequent retrieval attempt on the target. Craving strength was measured at the end of the experiment. Results indicated that JOLs for cravers were less realistic which may have been due to the presence of cravings.

Kemps and Tiggemann, (2010) define cravings as the intense motivation to obtain, ingest, or consume a substance. We adopt this definition: conceptualising cravings as a state of motivation. Cravings for various substances (e.g., tobacco, alcohol and chocolate, have been found to impair cognition (Heckman et al., 2013; Kemps & Tiggemann, 2009a; 2009b; Sinha et al., 2009; Smeets, Roefs, & Jansen, 2009; Tiggemann, Kemps, & Parnell, 2010; Uva et al., 2010; Zuj, Palmer & Kemps, 2015). As cravings consume cognitive resources, fewer resources are available for other important cognitive tasks (May, Andrade, Kavanagh, 2012; May, Andrade, Panabokke, & Kavanagh, 2004; Sayette & Hufford, 1994). The effects of cravings on cognition include deficits in working memory, memory, attention, visual processing, motivational salience (Bonson et al., 2002; Field, Munafo, & Franken, 2009; Meule, Skirde, Freund, Vogele, & Kubler, 2012; Naim-Feil, Fitzgerald, Bradshaw, Lubman, & Sheppard, 2014; Steel, Kemps, & Tiggemann, 2006).

We aimed to replicate the effect of coffee cravings on cognition and to look at whether cravings also affect metacognition. Metacognition can be defined as an individual's knowledge of how their own cognitive and memory processes function (Koriat, 2007). Theories such as Koriat's (1997) cue-utilisation hypothesis predict that cravings will impair metacognition due to metacognition's reliance on cues. We extend this research into higher order metacognitive judgements by investigating if and how metacognitive processes such as Judgements of Learning (JOLs) and Feeling of Knowing (FOKs) are affected by in vivo craving exposure via the use of coffee and a related imagery task. Doing so may provide insight into how metacognitive judgements function and whether they are largely deliberatively and analytically formed or automatic and heuristic driven (Metcalf & Finn, 2008).

How are cravings measured?

Cravings have generally been measured via visual analogue scales (VAS) measuring craving intensity (Kemps & Tiggemann, 2009a; Townsend & Heit, 2011). This requires a participant to view a scale that ranges from ‘no desire or urge to consume coffee’ to an ‘extremely strong desire or urge to consume coffee (Kemp, 2009b). To avoid alerting participants that their cravings were of interest, VAS measures are usually collected after the dependent measures have been collected (Kemps & Tiggemann, 2009b). The VAS functions via self-report which is not impervious to criticism, but due to the nature of cravings (i.e., a subjective motivational state) one could argue for its utility (Green, Rogers, Elliman, 2000). While there are other options the research within smoking and food indicates that a VAS is a simple, cost effective, and valid measurement instrument (Kemps & Tiggemann, 2009b; Zuj, Palmer, & Kemps, 2015).

How do cravings work?

Theoretical perspectives on substance dependence can help elucidate the mechanisms underlying cravings. Cravings research has largely followed the direction of substance use disorders such as alcohol dependence (Kavanagh, D, May, & Andrade, 2009; Ramirez, Monti, & Colwill, 2014). According to Koob and LeMoal, (2001) drug taking results in two processes occurring: (1) the drug elicits a pleasurable effect upon the individual; (2) a compensatory effect occurs in which the individual returns to homeostasis. The authors note that with continued use the pleasurable effects of the drug are less pronounced due to increased tolerance and this increased tolerance results in an inability to return the individual to the normal range of reward functioning. It is at this point that withdrawal symptoms occur as the result from reward mechanisms being poorly regulated in the brain (Robinson & Berridge, 2008). Robinson and Berridge’s, (1993) incentive salience theory of

addiction suggests that during continued exposure to drug-taking a Pavlovian conditioned response occurs. After frequent drug-taking, cues become enmeshed with the taking of a drug leading to drug and drug cue saliency which proceeds to create cravings related to obtaining the drug in question. Thus, drug cues can function as a conditioned reinforcer leading to possible drug taking and associated behaviours (Robinson & Berridge, 1993). This process has been termed Pavlovian-instrumental transfer and while relating largely to illicit substances the argument could also be applied to licit substances such as coffee (Dickinson, Smith, & Mirenowicz 2000; Kems 2009b).

Pavlovian-instrumental transfer is typically tested using the cue-reactivity paradigm (Dickinson, Smith, & Mirenowicz, 2000). The paradigm exposes substance abuse sufferers to cues that are related to the process of taking drugs (e.g., related situations or environments, and paraphernalia such as needles). Cue-reactivity has been studied in various samples (e.g., alcoholics, smokers, and heroin and cocaine addicts) and using varied cue presentation methods e.g., photographs of cues, imagery and in vivo exposure (Carter & Tiffany, 1999; Kems, & Tiggenmann, 2015; Tiffany & Drobos, 1990). Cue-reactivity is commonly measured via self-report, although physical measures are possible (Tiffany, Carter, & Singleton, 2000). The same cue-reactivity paradigm will be employed in the current study looking at coffee cravings with the use of craving strength self-report measures and imagery and in vivo exposures to coffee. The justification for this method comes largely from Kems (2009b).

Recently, researchers have begun using fMRI paradigms to (1) identify brain regions involved in cravings and addiction and; (2) test pre-existing theories of addiction and inform new theories of addiction and cravings (Engelmann et al.,

2012). The use of fMRI techniques has largely been focussed upon the neural substrates of smoking cue reactivity according to Engelmann et al., (2012). But the findings may be applied to substances typified by high levels of dependency in order to inform general theory and identify differences between substances and substance specific cues according to the author.

Engelmann's et al., (2012) meta-analysis looked at the neural substrates of cue reactivity in deprived and non-deprived smokers indicated that in deprived smokers, several areas of the brain largely within the extended visual system showed higher activation levels in response to smoking cues. Engelmann et al., (2012) suggests this may be due to increased allocation of attentional resources as the smoking cues are arousing for deprived smokers. Researchers looking at attention via the presentation of emotional stimuli and neutral stimuli have found that large areas of the extended visual system elicit larger responses to the emotional stimuli compared to the neutral stimuli (Bradley et al., 2003; Lang et al., 1998; Sabatinelli, Lang, Keil, & Bradley, 2007) supporting Engelmann et al., (2012) claim. This leads one to consider that substance related cues may reduce the attentional resources allocated to an associated cognitive task if the person is experiencing cravings (Kemps & Tiggemann, 2009b; Zuj, Palmer, & Kemps, 2015)

Engelmann et al., (2012) suggest that additional resources may be shifted to smoking cues when smokers have had a period of abstinence due to a region in the lingual gyrus consistently being activated more in those who abstained compared to those who did not. This hypothesised explanation does have some credence especially considering Robinson and Berridge's (2003) argument that long term drug abuse may result in drug cues being attributed with incentive salience, which may be even more likely when sufferers are in periods of abstinence (Drummond, 2000).

This may result in a perceptual bias towards smoking valence cues which has also been found in other domains such as food related cues (Calitri, Pothos, Tapper, Brunstrom, & Rogers, 2010; Koob & LeMoal, 2001; Robinson & Berridge, 2008).

Why do cravings lead to a decrease in cognitive task performance?

Studies investigating cravings have largely revolved around alcohol, smoking, and food (including coffee), via the use of in vivo exposure and imagery tasks (Green, Rogers, & Elliman, 2000; Harvey, Kemps, & Tiggemann, 2005; Kemps & Tiggemann, 2009a; 2009b; Sinha et al., 2009; Tiffany & Hakenewerth, 1991). These studies generally demonstrate that cravings result in decreased performance on a cognitive task (e.g., reaction time or working memory capacity tasks) (Zuj, Palmer, & Kemps, 2015; Zwaan, Stanfield, & Madden, 2000). This is due to cravings consuming finite cognitive resources resulting in fewer being available for other cognitive tasks (Kemps & Tiggemann, 2009b). Expanding this further, when cravings occur subsequent action schemas are triggered (i.e., automatic behavioural patterns which aim to satisfy the craving such as purchasing cigarettes or going to a café to buy a coffee) and because these action schemas are implemented automatically, few cognitive resources are required for them to be performed - however, resources are required to suppress them (Tiffany, 1990).

Via the use of a cognitive-experimental paradigm evidence suggests that imagery can elevate food craving (Kemps & Tiggemann, 2010). Kemps, Tiggemann, and Grigg, (2008) used an induction task in which participants were experimentally induced via exposing participants to chocolate after abstaining from consuming chocolate for 24 hours. The results indicated that cravers demonstrated working memory deficits (the ability to store information while processing other information) and slower reaction times in an operation-span task where participants were tasked

with remembering a set of words in addition to also solving mathematical problems (Kemps, Tiggeman, & Grigg, 2008). The authors attributed this to habitual cravers allocating limited cognitive resources to cues that were associated to cravings which reduced their performance on a cognitive task. While action schemas are implemented automatically, this result adds support to the notion that cognitive resources are required to suppress craving action schemas (Tiffany, 1990).

Why should we be concerned?

The influence of cravings may significantly impair one's ability to maintain professional standards, accuracy in work may fall due to reduced attention, or information may be forgotten. One may argue that due to coffee being a socially accepted substance the concern should not be as great compared to an illicit substance such as heroin, but the fact that coffee cravings have been found to reduce performance indicates that the severity and the ability of coffee cravings to influence cognitive performance should not be underestimated (Kemps & Tiggemann, 2009b).

What is metacognition?

Koriat (2007) broadly defines metacognition as an individual's knowledge as to how their own cognitive and memory processes function. Simply put, metacognition provides one with privileged access to their own mind and allows one to critically evaluate, monitor, and control what they learn, how they learn it, and how they can recall or recognise that information effectively (Nelson & Narens, 1990). Metacognition can be viewed as a purely individualistic reference and feedback provider of how an individual thinks about their own ability to think and learn.

Metacognitive research has largely followed two paths: memory research and developmental psychology. Within the developmental research paradigm the

assumption is that metacognition and its associated processes are fundamental in learning and memory development (Dunlosky & Metcalfe, 2009; Koriat, 2007).

Research in the developmental paradigm has aimed to track metacognitive development and see how metacognition influences cognition (Koriat 2007). Within the domain of memory research, the focus has been on investigating the mechanisms that allow individuals to monitor their own knowledge, and whether self-monitoring affects how individuals learn content (Dunlosky & Metcalfe, 2009; Koriat, 2007; Son & Metcalfe, 2005).

Research in the memory paradigm has stemmed from studies investigating feeling-of-knowing (FOK; Hart, 1965) i.e., the feeling that a person knows the answer to a question but is unable to access it directly, and studies looking at the tip-of-the-tongue phenomena (TOT; Brown & McNeill, 1966) i.e., a feeling that accurate retrieval is imminent due to partial recall of the item after failing to retrieve an item. These were the first studies to look at metacognition from a memory process view point (Koriat 2007). While both of these paths have inherent utility, the current study aims to discover whether these judgements are based purely on memorial retrieval or on the utilisation of cues.

How is metacognition measured?

While a myriad of metacognitive judgement paradigms have been used experimentally, the two judgements with the most research backing are JOLs and FOKs (Koriat, 2007; Dunlosky & Metcalfe, 2009). The current study will focus on JOLs, specifically delayed JOLs (Nelson & Dunlosky, 1991). Metacognitive measurement taps into the extent in which metacognitive judgements can predict performance on a future-orientated cognitive task (Dunlosky, Serra, & Baker, 2007). This has largely been measured by coefficients such as Goodman-Kruskal's (1954)

gamma (G), Adjusted Normalised Residual Index (ANRI), Over/Under confidence (O/U) and Calibration coefficients (C). See the results section for a description of ANRI, O/U, and Calibration. Goodman-Kruskal's (1954) gamma has largely been used to assess confidence-accuracy correlations. The problem with gamma is that it can be affected by metacognitive bias according to Fleming and Lau, (2014). For example, gamma can be influenced by one's tendency in whether they report high or low confidence overall (Masson & Rotello, 2009). This indicates that gamma can be influenced by variables outside of metacognition such as individual personality factors (Fleming & Lau, 2014; Yaniv, Yates, & Smith, 1991). The use of ANRI aims to remove the bias in determining one's discrimination ability resulting in a more impermeable measure of discrimination (Fleming & Lau, 2014).

JOLs. JOLs can be defined as a judgement made by an individual regarding the likelihood of remembering items studied recently on a future test (Dunlosky, Serra, & Baker, 2007). JOLs can be split into different categories but within the current study paired-associate judgements will be used. Paired associate judgements differ from other categories in that JOLs are made during the study of cue-target word pairs and incorporate a prediction on future memory performance (Schwartz, 1994). Within paired associate judgements one can use a cue-only JOL where the cue word is shown to the participant and they must estimate how likely they would be to recall the target word (Metcalf & Dunlosky, 2008). One can also use a cue-target JOL whereby the participant is presented with the cue and target word and must estimate how likely they would be to recall the to-be target word in the future. Once JOLs are made participants are asked to enter the target words for all word pairs if they are able. This allows researchers to compare recall ability (i.e., could participants recall the right target words that matched the associated cue words) and

JOL accuracy which compares one's JOL estimate to their average recall percentage (Dunlosky & Metcalfe, 2009; Koriat, 1997; 2006).

Delayed JOLs. Nelson and Dunlosky, (1991) found that JOLs that were made after a small time delay after stimuli were studied resulted in an increased ability in delineating between items that were learned well and items that were not learned well. When a cue-target JOL was made the accuracy of the JOL was significantly lower than cue-only JOL accuracy (Dunlosky & Nelson, 1992).

Three main theories have been put forward to explain delayed JOLs. Firstly, the monitoring dual memories hypothesis (Nelson & Dunlosky, 1991) which states that immediate JOLs are based on retrieval from short and long term memory (Metcalfe & Finn, 2008). Due to the judgement occurring almost immediately, the authors suggest that the target will only be in STM and a retrieval attempt via LTM will not occur resulting in poor discrimination. Conversely delayed JOLs rely purely on LTM retrieval which the authors note as having greater predictive utility.

Secondly, the transfer appropriate processing view (Begg, Duft, Lalonde, Melnick, & Sanvito, 1989) states that delayed JOLs utilise retrieval that is more similar to what may be used at testing compared to immediate JOLs. Finally, the self-fulfilling prophecy (Kimball & Metcalfe, 2003) suggests that the increase in delayed JOL accuracy is due to JOLs themselves enhancing memory due to the utilisation of retrieval. From these theories the process of retrieval is a key and fundamental component in terms of explaining the delayed JOL effect (Son & Metcalfe, 2005; Metcalfe & Finn, 2008).

Why is metacognition important?

Studying metacognition is important in terms of education (enhancing one's ability to monitor task choice and outcome); organisational settings (judging one's

own actual level of task confidence compared to perceived confidence); forensic settings (eyewitness testimony confidence and memory malleability). From an educational setting metacognition is important as it requires one to reflect upon individual performance strengths and weaknesses and strategies for learning. This enables individuals to identify areas in which they may need additional resources or areas in which they are competent highlighting metacognition's importance, not just in terms of education but in all aspects of daily living (Metcalf & Dunlosky, 2008).

How does metacognition work?

It is important to draw attention to the metacognitive processes of monitoring and control as these are fundamental constructs in understanding how metacognition functions (Flavell, 1979; Nelson & Narens, 1990). The framework depicted by Nelson and Narens, (1990) postulates that cognitive processes may be split into those that occur at the object level (i.e., encoding and retrieval) and those that occur at the meta level such as monitoring (i.e., monitoring basic cognitive processes such as encoding or comprehension) and control (i.e., modifying object level functions such as incorporating rehearsal if content is hard to recall) (Koriat, 2007).

Monitoring allows an individual to observe and experience their own cognitive processes, whereas control takes the form of decisions made largely on the basis of these monitoring processes (Nelson & Narens, 1990). An example of metacognitive monitoring would be when students subjectively and consciously assess how well they know course content, whereas metacognitive control would be when a student has an exam and differentially allocates study time based on perceived strengths and weaknesses (Dunlosky, Serra, & Baker, 2007; Finley, Tullis, & Benjamin, 2010). Koriat, (2006) acknowledges that a common assumption within metacognitive research is that metacognitive control is shaped by the overarching

and guiding nature of metacognitive monitoring. Thus, to effectively manage one's own learning, one must first be able to effectively monitor their knowledge and understanding to highlight areas that may need additional resources (Ackerman & Goldsmith, 2011; Ariel, Dunlosky, & Bailey, 2009; Thiede & Dunlosky, 1999; Tullis & Benjamin, 2011).

Koriat's (1997) Cue Utilisation hypothesis

Koriat's (1997) cue-utilisation hypothesis suggests that JOLs are similar to FOK judgements as both are largely inferential and based on an implicit application of heuristics while attempting to obtain an accurate idea of how likely information is to be recalled time. Koriat (1997) argues that JOLs do not depend on a person directly accessing and monitoring the strength of a memory trace (i.e., encoding strength), but rather on the use of cues which are generally predictive of memory performance. For example, JOLs depend more on heuristics such as how familiar a cue is compared to how strongly the target was encoded.

It is important to note that due to being based on inferences and heuristics, JOL accuracy will not always be high (Metcalf & Dunlosky, 2008). The predictive value of JOLs will vary depending on the inferences and heuristics discussed by Koriat, (1997). Koriat (1997) differentiates three types of cues: (1) intrinsic; (2) extrinsic and; (3) mnemonic cues. Intrinsic cues include characteristics of to-be-studied items which the individual believes may signify the item's ease of learning or difficulty in learning such as item relatedness. Extrinsic cues include characteristics of the learning condition such as how many times the item was presented or how long the items were studied for (e.g., I would be more likely to recall items that were presented more than others) (Koriat, 1997). Extrinsic cues also include how an individual encoded cue information such as an item's level of

processing by the individual and if/how they used imagery when encoding (e.g., in seeing coke-can, participants may encode the cue as being related to the target resulting in participants believing that the target will be recalled easier) (Koriat, 1997). Koriat (1997) notes that intrinsic and extrinsic cues may influence also indirectly influence JOLs via their influence on mnemonic cues.

Mnemonic cues are defined as internal indicators which indicate the extent to which an item is learned (Koriat, 1997; 2006). Examples of mnemonic cues include familiarity of the cue word, encoding fluency, and the accessibility level of related information. For example, participants view the word pair of ghost-cart, this results in an internal feeling that ghost is already readily learned due to being exposed to that cue word more than others outside of the experiment. This may result in ghost being more familiar to the participant, possibly influencing how likely the target will be recalled (Dunlosky, Serra, & Baker, 2007).

Theoretical models of metacognition

Sitting beneath the cue-utilisation hypothesis two differing opinions exist in how these cues function. In terms of if cravings would affect JOLs the experience-based view would suggest that JOLs would be influenced whereas the theory-based view would suggest that cravings would not influence JOLs. Theory-based JOLs differ from experience-based JOLs in that theory-based JOLs rely largely upon beliefs and theories which inform JOLs. In this instance JOLs depend on aspects of the study material such as item-relatedness (intrinsic cues) or on what the conditions of learning may be such as if items are presented more than once (extrinsic cues). An example, would be that a person theorises that accurate word-pair recall should increase if word pairs are related (e.g. dog-cat) or if they get to see dog-cat more than once. How does this then relate to cravings? Theory-based JOLs, due to relying on *a*

priori beliefs would then be assumed to be unaffected by cravings as what is argued to determine JOLs in this context is how one applies preconceived ideas and theories. Thus, while cravings may reduce cognition resources to encoding, a person would apply their own modelling in determining what could be recalled and what may not be based upon their own ideas and conditions of the experiment. Examples of theories that utilise the theory-based approach include: (1) the monitoring-dual-memories hypothesis (Nelson & Dunlosky, 1991); (2) the transfer-appropriate monitoring hypothesis (Begg, Duft, Lalonde, Melnick, & Sanvito, 1989); (3) the self-fulfilling prophecy hypothesis (Spellman & Bjork, 1992; Kimball & Metcalfe, 2003) and; (4) the stochastic drift model (Sikstron & Jonsson, 2005).

Conversely, Experience-based JOLs are said to be largely based upon mnemonic cues which give rise to on-line task performance (Koriat, 1997). Simply put mnemonic cues inform metacognitive judgements such as JOLs via heuristics which function below one's consciousness. JOLs, using heuristics such as encoding fluency or ease of retrieval would inform how likely target words would be recalled in terms of the present study. Due to cravings reducing cognitive resources in these areas (e.g., working memory) cravings would be expected to constrain mnemonic cues, thus denigrating JOL accuracy. Furthermore, if these heuristics operate below consciousness one would not be able to critically evaluate the accuracy of these mnemonic cues (i.e., a person would not be able to correct their JOLs) so it may also result in a further denigration of performance because a person may use mnemonic cues that are inaccurate. A theory that utilises aspects of the experience-based approach include Son and Metcalfe's, (2005) delayed JOL mode. The authors argue that delayed JOLs contain two processes: (1) a pre-retrieval stage suggested to be based on cue familiarity and; (2) a stage in which judgements are based on the

fluency of retrieval or another aspect of the target such as associated cues which one may only be aware of once retrieval has been attempted. This indicates that JOL accuracy should largely be determined via the presence of mnemonic cues.

One key difference within this theory is that the authors suggest that the mnemonic cue of cue familiarity may be separate from other mnemonic cues in that it may originate not from an attempt at retrieval but from a stage prior to retrieval matching a similar theoretical perspective regarding FOKs (Koriat, 1993; 1995; Son & Metcalfe, 2005). Koriat's (1993) accessibility hypothesis suggests that FOKs function as a by-product of the retrieval process where the goal is to identify a target. When delayed JOLs and cue-only JOLs are used, it appears that JOLs, like FOKs, function as a by-product of the attempted retrieval process i.e., the outcome of the retrieval process acts as heuristic to infer the strength of a target, (Koriat, 1993). As such these judgements are then largely based upon the quantity of information that is retrieved about the target and most importantly – irrespective of whether that information is accurate (Koriat, 1993). This draws parallels with the idea that manipulations that affect retrieval then should also affect JOLs as JOLs are based upon the by-products of the retrieval process (Metcalfe & Finn, 2008). Son and Metcalfe, (2005) suggest that JOLs like FOKs may then be based upon an evaluation of available cues which are available before the retrieval process and a fast preliminary assessment phase which can explain fast low JOLs (i.e., I do not know).

Summary

The aim of this study was to use a sample of regular coffee drinkers to investigate how cravings may influence JOL judgements when completing a cue-only word pair task. Koriat's (1997) cue-utilisation theory of JOLs attests that the JOL itself is largely automatic but that is influenced by cues which are heuristically

driven (i.e., not automatic and requiring attention). While we may not be able to directly influence the JOL through craving induction the assumption might be that we are able to indirectly influence JOLs by reducing the capacity of the individual to use cues to inform the judgement as the required resources are utilized in attending to the craving.

The proposed study has two hypotheses: (1) those in the craving group who have abstained from drinking coffee on the day of testing will report significantly higher craving strength ratings as measured by the VAS on all four time points compared to controls; (2) that cravers will accurately recall significantly less target words than controls overall. The proposed study also aims to explore the nature of JOLs. If JOLs function predominately via long term memorial retrieval ability one would expect that JOL accuracy, as measured by calibration, over/under confidence, and resolution would not significantly differ to controls. Conversely, if JOLs function predominately via the utilisation of cues and heuristics which may suffer from reduced accuracy due to cravings, one would expect that JOL accuracy would be significantly lower for cravers as measured by calibration, over/under confidence and resolution.

Method

Participants

Participant characteristics. Sixty-seven participants participated in the study, of which 23 were male, 42 were female and two indicated their sex as ‘other’. Ages ranged from 18 to 69 years (controls: $M = 26.34$, $SD = 8.20$; cravers: $M = 31.30$, $SD = 13.83$). The sample contained 29 participants from the general Hobart area of Tasmania and 38 participants from the general Bedford Park area of South Australia (See Appendix A for ethics approval).

Sampling procedures. Stratified sampling was used in which eligibility criteria required prospective participants to consume coffee a minimum of once per day and to enjoy the taste of coffee (i.e., coffee consumption was due to a desire to consume coffee and not to secondary effects of caffeine such as mental alertness). Twenty-nine participants were tested at University of Tasmania (UTAS) and 38 participants were tested at Flinders University. This took place in two rooms: one where participants engaged in a customised computer program and another used to invoke cravings. Participants received a \$20 Coles/Myer gift card for participating or 90 minutes course credit if they were a first year psychology student.

Power. The intended sample size for this study was between 80 and 120 participants. A Cohen's d of .50 would equate to power of .80 requiring 128 participants with 64 in each condition according to G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). With 67 total participants (32 controls and 35 experimentals) and holding Cohen's d at .5 power dropped to .52.

Materials and Procedure

Allocation. Those who met the selection criteria were allocated to either the control the craving group based on the condition of the session in which they were able to attend. An excel spreadsheet, using =RANDBETWEEN 1,2 was used to randomly allocate sessions. Pure random allocation was not possible due to room constraints in that testing often included more than one individual at a time which may have resulted in participants being aware of what the other group was doing thus possibly influencing the results. Participants were then informed whether they had to abstain from coffee on the day of testing (see Appendix B) or continue *ad libitum* (see Appendix C), matching Kemps and Tiggemann's, (2009b) protocol. Groups were tested separately so the control group could not smell coffee.

Information and consent. On arrival participants were given an information form regarding what was being investigated. Two versions of this form were used so as those in the control group were not aware of the experimental group's requirement to abstain from coffee (see Appendix D & E). Participants also completed a consent form (see Appendix F).

Descriptive information. Participants completed a descriptive information form (see Appendix G). This form contained six questions regarding: (1) sex; (2) age; (3) what was their average coffee consumption per day on average in servings; (4) had they consumed any other caffeinated substances in the last 24 hours; (5) how many hours had passed since they last ingested coffee and; (6) were they a first year psychology student. The purpose of these questions was to obtain as much information about participants coffee consumption as possible so as to identify possible confounds such as whether the amount of coffee abstinence between controls and cravers was sufficient (Kemps & Tiggemann, 2009a; 2009b).

Program. A customised E-Prime (Psychology Software Tools, 2012) program was used in this study which consisted of four phases. Firstly participants were presented with 100 non-sensical noun cue-target word pairs one-by-one that were controlled for imaginability, concreteness, length and frequency via the use of a psycholinguistic database. Secondly, participants were presented with the first word of every word pair and were asked to enter how likely they would be able to recall each missing target word on a 0 to 100 scale where 100 equalled being certain to recall the target word and 0 being uncertain, this was blocked into two blocks of 50 trials. Thirdly, participants were presented with the cue word of each cue-target word pair and were instructed to enter the target word if able; this also consisted of two 50 block trials. Fourthly, participants then completed a FOK judgement and a four-

alternative-choice task that was a part of another thesis. During JOL estimation and recall, after 50 trials had been completed a screen would appear that would instruct participants to have a break. This screen contained a picture that was dependent on the condition. Controls viewed a beach scene and cravers viewed a cup of coffee. These images were used to control for any craving dissipation that may have occurred quickly after the induction task (Kemp, Tiggemann, & Grigg, 2008; Kemp, Tiggemann, 2009a; 2009b; Madden & Zwann, 2001; Zwaan, Stanfield, & Madden, 2000; Zwaan & Truitt, 1998).

Control manipulation. Those in the control group completed an imagery and exposure task at two points within the experiment. Controls were instructed to pour a glass of water from a jug before being read an imagery-based paragraph. An orange based air freshener was also sprayed in the room prior to them entering. Controls were read a paragraph that was adapted from Baylen, (2007) on smoking cravings (see Appendix H) which instructed participants to imagine being on their favourite holiday and to imagine the associated smells and sounds regarding that experience. This task was completed after participants encoded the 100 word pairs and again after they had attempted to recall all 100 target words. A holiday was used as it is not a substance which may have influenced coffee craving ratings. The use of a holiday has also been used as a control manipulation in previous research as it does not induce a craving but is desirable (Green, Rogers, & Elliman, 2000).

Craving manipulation. Those in the craving group were given an alternative imagery and exposure task at two points within the experiment. Cravers were instructed to view and pour a cup of freshly brewed coffee from a plunger before being read an imagery-based paragraph. Cravers were read a paragraph that was also adapted from Baylen, (2007) (see Appendix I) on smoking cravings which instructed

participants to imagine consuming a cup of their favourite coffee at that moment and to imagine smells associated with consuming that coffee (Tiggemann & Kemps, 2005). This task was completed after participants encoded the 100 word-pairs and again after they had attempted to recall all 100 target words.

Post-experimental measures. A retrospective VAS (see Appendix J) similar to the one used by Kemps, Tiggemann, and Grigg, (2008) measuring levels of craving was used to measure cravings for four time-points: (1) when the participant arrived at the experiment; (2) at the completion of the first imagery and exposure task; (3) at the completion of the second imagery and exposure tasks and; (4) at the end of the experiment. The reason for using a retrospective VAS was that we did not want to possibly induce cravings in the control group and those in the craving group may have reported inaccurate ratings due to knowing that cravings were being evaluated (Kemps, Tiggemann, & Grigg, 2008). Participants then completed a trait caffeine craving questionnaire in the form of an Attitude to Caffeine Questionnaire (ACQ) which was adapted from a trait scale looking at chocolate (Benton, Greenfield, & Morgan, 1998). Participants also completed a Caffeine Dependence Questionnaire (CDQ; adapted from Raistrick et al., 1994). These two questionnaires were used to obtain a baseline measure of participant's attitudes to caffeine and assess possible caffeine dependence (see Appendices K & L). Participants also received a debrief form (see Appendix M). Words used can be found in Appendix P.

Results

Data Screening

Within the descriptive data there were four instances where data was missing, these instances were left blank. Answers that were inputted during testing and were outside the possible value ranges were identified and moderated by the

experimenters. The process was used to control for data entry and spelling errors. If an error could not be corrected with confidence it was deleted and recorded (see Appendix N). Z-scores were calculated for VAS time-points and JOL accuracy coefficients which identified one value having a z-score larger than 3.29 which may have indicated an outlier in the craving group. According to Tabachnick and Fidell, (1996) the probability of sampling a score that high was 0.001, and as such analyses were conducted on JOL calibration including and excluding the outlying score to see its influence on the results. JOL calibration excluding the z-score was non-significant, $t(64) = -1.67$, $p = .10$, 95%CI [-.05, .00], $d = 0.42$. Due to the small change in the results the outlier was retained. Inspection of histograms indicated that on average data was normally distributed (see Appendix O).

Descriptive information

The following information was used to determine if differences other than those due to the craving manipulation had occurred, possibly influencing how the results were interpreted. There was no significant difference in terms of sex between controls and cravers, $t(65) = .014$, $p = .989$, $d = 0.003$. There was no significant difference in age between the control ($M = 26.34$; $SD = 8.18$) and the craving group ($M = 31.30$, $SD = 13.83$), $t(55.9) = -1.80$, $p = .078$, $d = 0.48$. There was also no significant difference in the number of coffee servings per day between controls ($M = 1.97$; $SD = 1.03$) and cravers ($M = 2.06$; $SD = .97$), $t(65) = -.36$, $p = .719$, $d = 0.089$. Reports of caffeine intake in the 24 hours before the experiment did not significantly differ between controls ($M = .56$; $SD = .50$) and cravers ($M = .38$; $SD = .49$), $t(65) = 1.47$, $p = .147$, $d = 0.36$. There was a significant difference in the amount of hours since coffee was consumed by participants, with cravers ($M =$

12.09; $SD = 2.75$) abstaining significantly longer than controls ($M = 4.69$; $SD = 4.87$), $t(47.9) = -7.56$, $p < .001$, $d = 2.18$, see Figure 1.

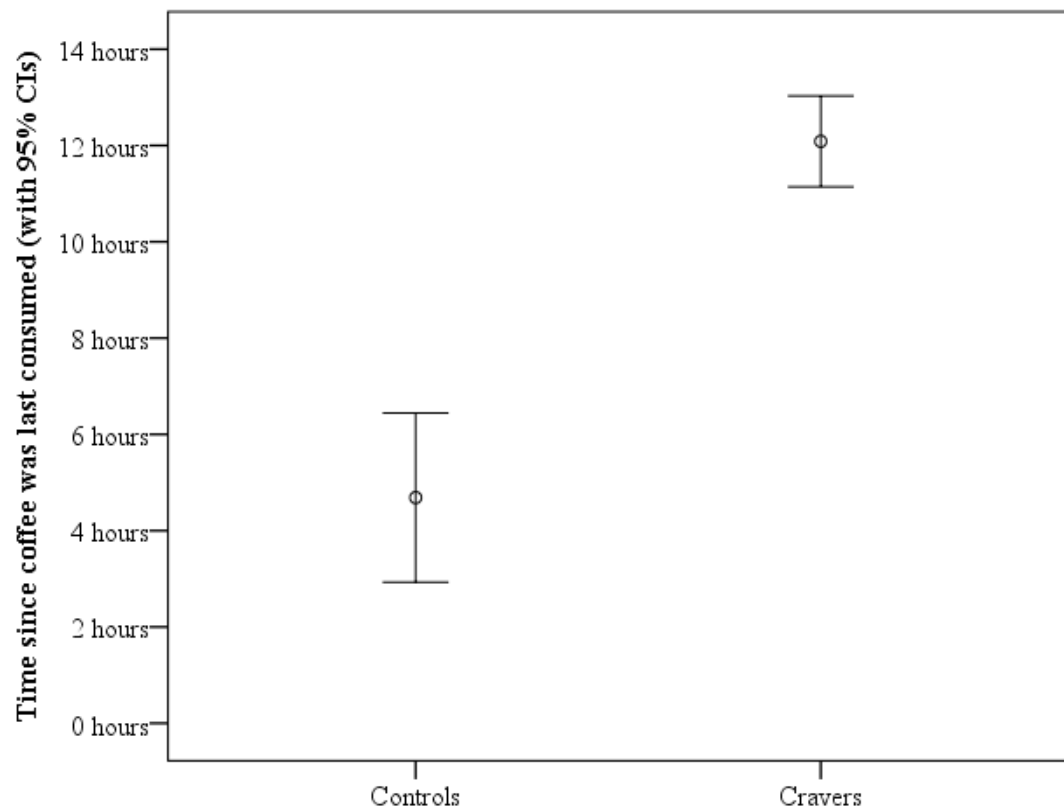


Figure 1. Mean number of hours since coffee was last consumed by controls and cravers.

There was also a significant difference in 1st year psychology undergraduate status between controls and cravers although 50.7% of the sample was incorrectly coded. There was no significant difference in self-report ratings between controls ($M = 6.44$; $SD = 1.05$) and cravers ($M = 6.34$; $SD = .84$), in terms of liking the taste of coffee, $t(65) = .41$, $p = .683$, $d = 0.10$. This indicates that the craving manipulation was successful and differences outside of those attributed to the manipulation were not found, increasing the utility of the following results.

Craving manipulation

A 2(condition: control, craving) x 4(VAS time-point: on arrival, end of first craving induction, end of second craving induction and end of study) mixed factorial ANOVA was utilised to determine craving strength levels measured by the VAS for each of the four time-points. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi^2(5) = 20.08$, $p = .001$ resulting in the use of a Greenhouse-Geisser epsilon correction ($\epsilon = .853$). Levene's test of homogeneity of variance was significant in regards to the second exposure task resulting in the ANOVA being interpreted with some caution. The ANOVA revealed a significant main effect of condition, in which cravers ($M = 76.27$; $SD = 3.94$; 95%CI [68.41, 84.14]) reported on average significantly higher craving ratings across all four time points compared to controls ($M = 36.74$; $SD = 4.12$; 95%CI [28.52, 44.97]), $F(1, 65) = 48.11$, $p < .001$, $\eta_p^2 = .425$, see Figure 2.

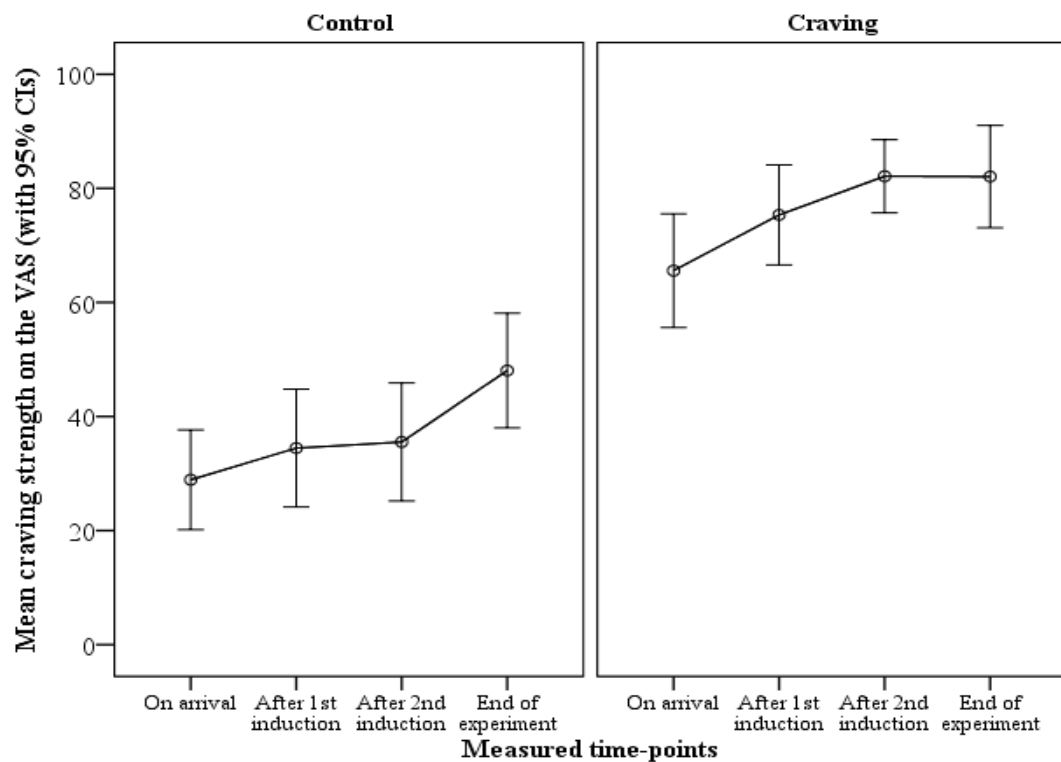


Figure 2. Mean craving strength ratings retrospectively reported via the VAS for controls and cravers.

The ANOVA also revealed a significant main effect of time-point in which, irrespective of condition coffee cravings increased linearly across all four time-points, $F(2.56, 166.33) = 19.16, p < .001, \eta_p^2 = .23$, following a Greenhouse-Geisser correction ($\epsilon = .853$), see Figure 2. The Condition x Time-point interaction trended towards significance although it was non-significant, $F(2.56, 166.33) = 2.59, p = .064, \eta_p^2 = .038$, following a Greenhouse-Geisser correction ($\epsilon = .853$). Inspecting Figure 2 it would appear that this interaction may indicate greater craving strength differences at the end of both induction tasks compared to the first and last time-points.

Recall Performance

It is important to differentiate two types of recall, namely quantity-based and accuracy-based recall. Quantity measures are input bound and usually test the quantity of information that can be recalled (Koriat & Goldsmith, 1996). Quantity measures assess the likelihood that every item is recalled (Koriat & Goldsmith, 1996). Accuracy measures examine the extent in which recalled information can be trusted by an individual as being correct (Koriat & Goldsmith, 1996). As participants were able to withhold from answering an item an element of metacognitive control was introduced (Koriat & Goldsmith, 1996). As such recall performance was tested in two different ways: (1) recall accuracy was assessed across all trials, which assessed the quantity of information provided and; (2) recall accuracy was assessed by assessing the accuracy only of responses that were volunteered by the participant.

An independent-samples t-test compared controls and cravers total recall accuracy across all trials (quantity). Controls ($M = .20; SD = .21$) accurately recalled

significantly more words than controls ($M = .09$; $SD = .12$) on average, $t(49.26) = 2.56$, $p = .014$, 95%CI [.02, .19], $d = .72$, see Figure 3.

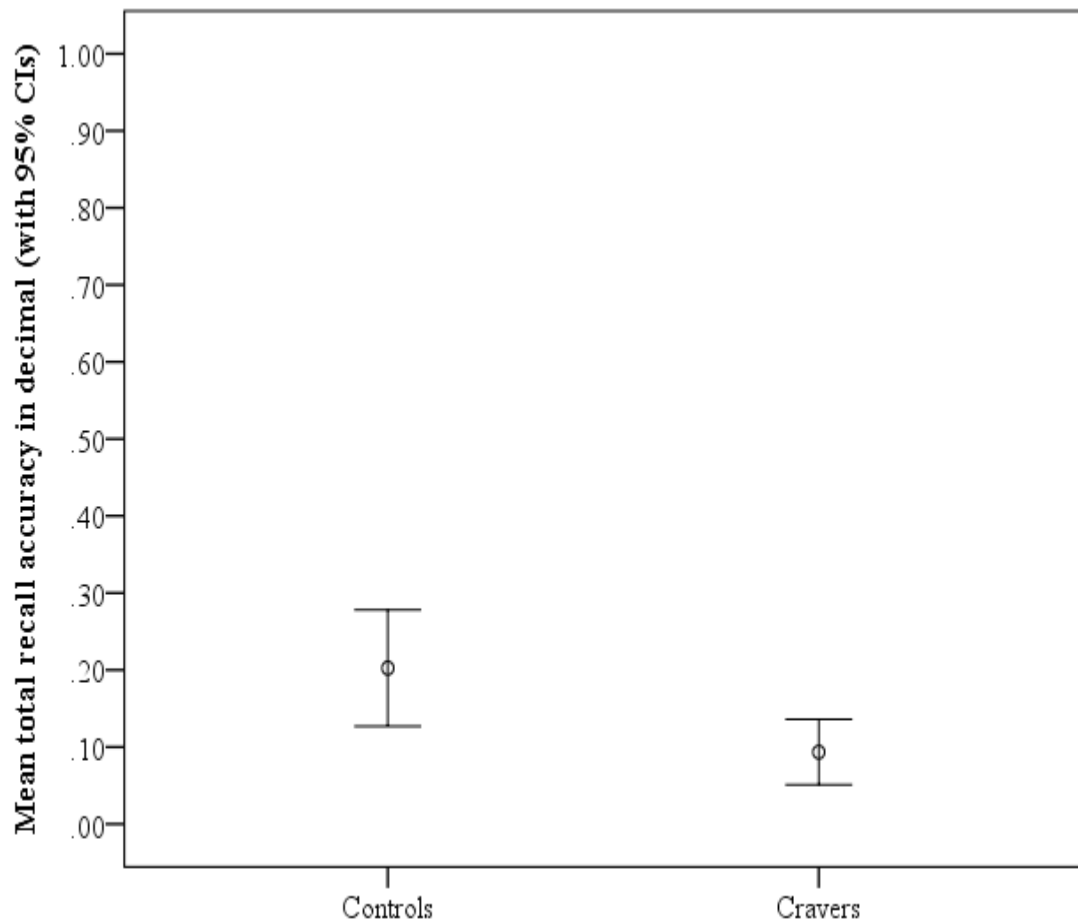


Figure 3. Mean recall accuracy in decimal for all responses for controls and cravers.

An independent-samples t-test compared controls' and cravers' recall accuracy only on trials where a word was volunteered by a participant (accuracy). There was no significant difference in how many words were accurately recalled between controls ($M = .58$; $SD = .27$) and cravers ($M = .44$; $SD = .29$), $t(65) = 1.98$, $p = .052$, 95%CI [.00, .27], $d = .49$, see Figure 4.

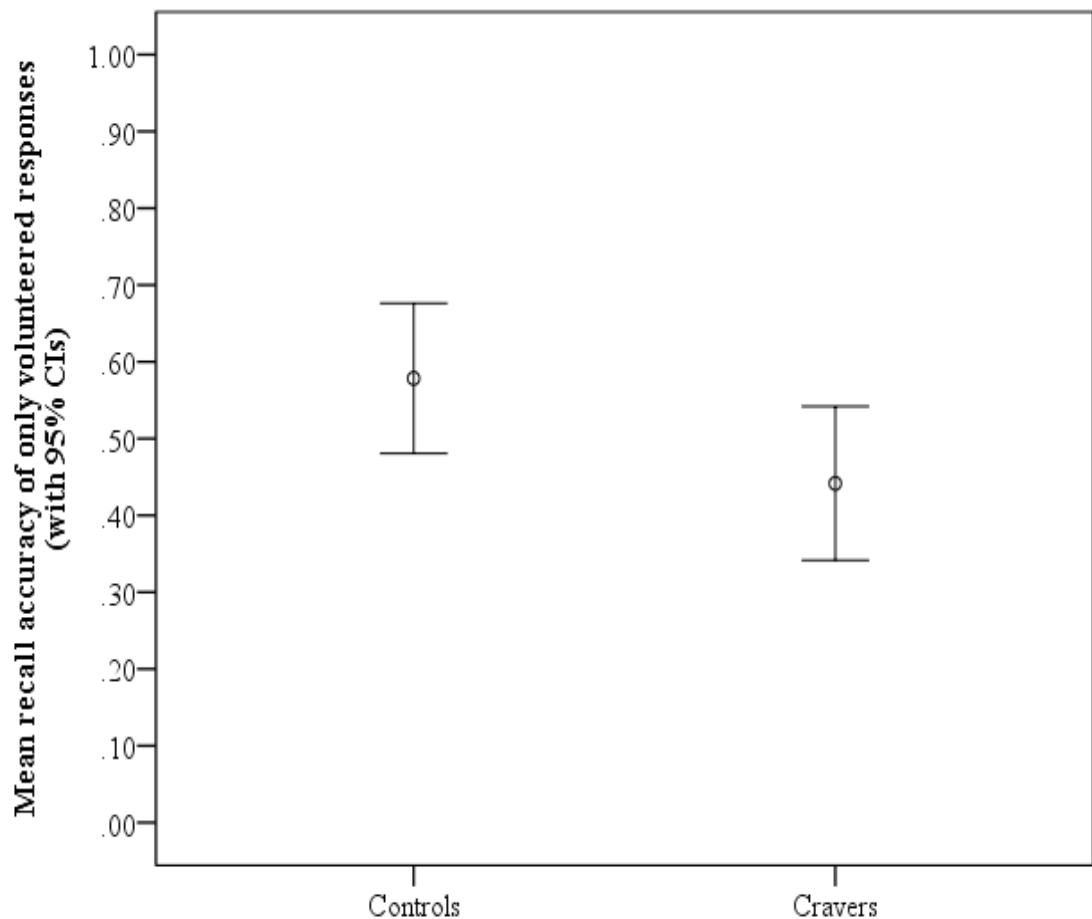


Figure 4. Mean recall accuracy in decimal only for responses that were volunteered by controls and cravers.

Although a borderline moderate effect size was identified, these results indicate that cravers appeared to have suffered from the craving manipulation in their ability to accurately recall target words compared to controls. While the results indicate that the quantity of information provided was reduced for cravers the effect size for only volunteered responses may provide tentative evidence that the accuracy of volunteered information may have been encumbered in cravers due to the craving manipulation.

JOL accuracy

JOL accuracy was calculated by comparing participants' JOLs to their subsequent word recall performance. JOL accuracy uses three main measures to understand the extent in which JOLs are predictive of future recall performance accuracy. These three measures are: (1) calibration, expressed as 'C'; (2) Over/under confidence, expressed as 'O/U' and; (3) resolution, expressed as 'ANRI'.

Calibration. Calibration surrounds how well JOLs correspond to future recall performance accuracy. For 'perfect' calibration participants would need to provide JOLs of 70%, and following that recall performance accuracy should be around 70%. To determine calibration a statistic commonly referred to as 'C' is used, this statistic functions on a 0 – 1 range with 0 meaning perfect calibration and 1 meaning non-existent calibration. 'C' is calculated using the formula below and conceptually relates to how realistic JOLs are in terms of subsequent recall performance (Brewer & Wells, 2006).

$$C = \frac{1}{n} \sum_{j=1}^J n_j (c_j - a_j)^2.$$

While the 'C' statistic has its utility, the use of a calibration curve enables the confidence-recall relationship to be inspected visually. Visual inspection allows conditions to be compared against a linear line representing perfect calibration while also enabling over or under confidence to be readily identified (Palmer, Brewer, Weber, & Nagesh, 2013). See Figure 5 as it provides an example with only the perfect calibration line.

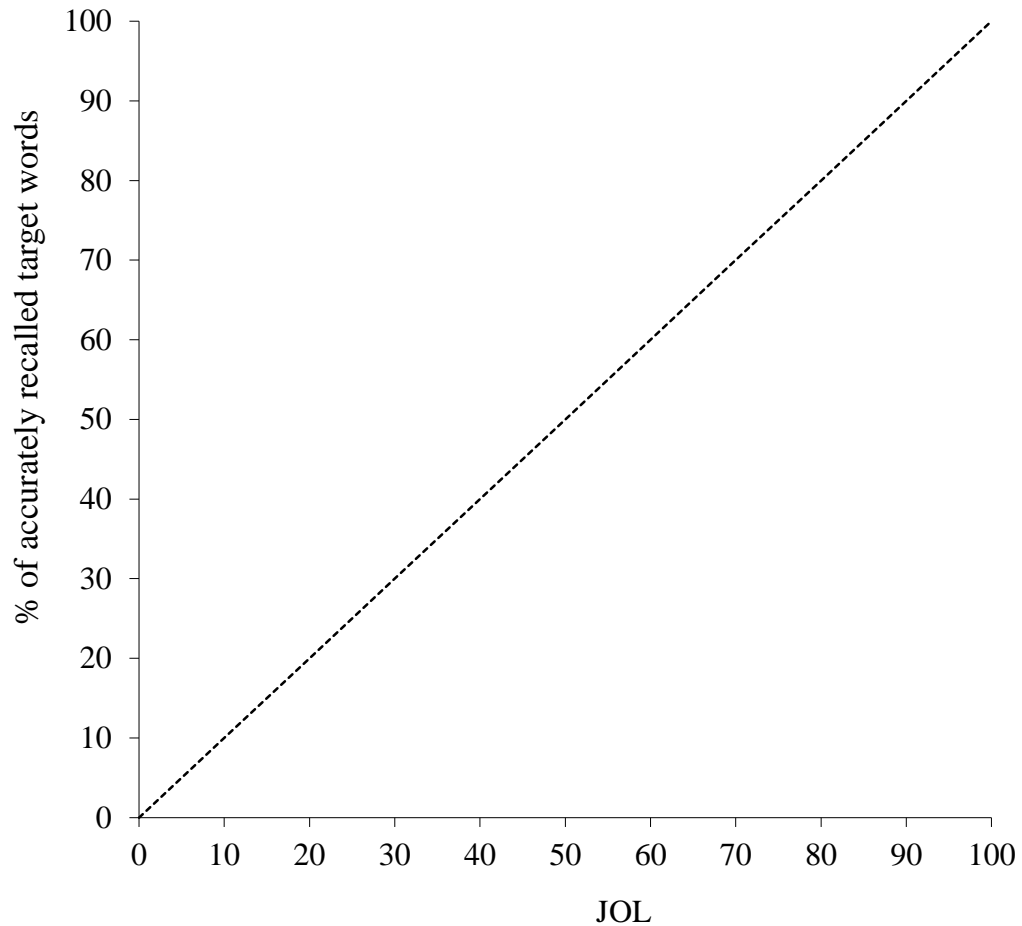


Figure 5. An example of a calibration plot with the perforated line of perfect calibration present only.

Figure 6 shows the JOL calibration curves for both controls and cravers. It appears that there is considerable overconfidence for both conditions with cravers appearing to suffer from overconfidence more so. The presence of a floor effect for cravers indicates that the JOLs made with less than 60% confidence resulted in accuracy levels of around 5%. In terms of ‘perfect’ calibration controls appear to be closer to that line compared to cravers indicating better calibration. For JOLs made with 75% ratings or more accuracy can be seen as readily increasing although at every JOL rating controls appear to be better calibrated and have higher recall accuracy.

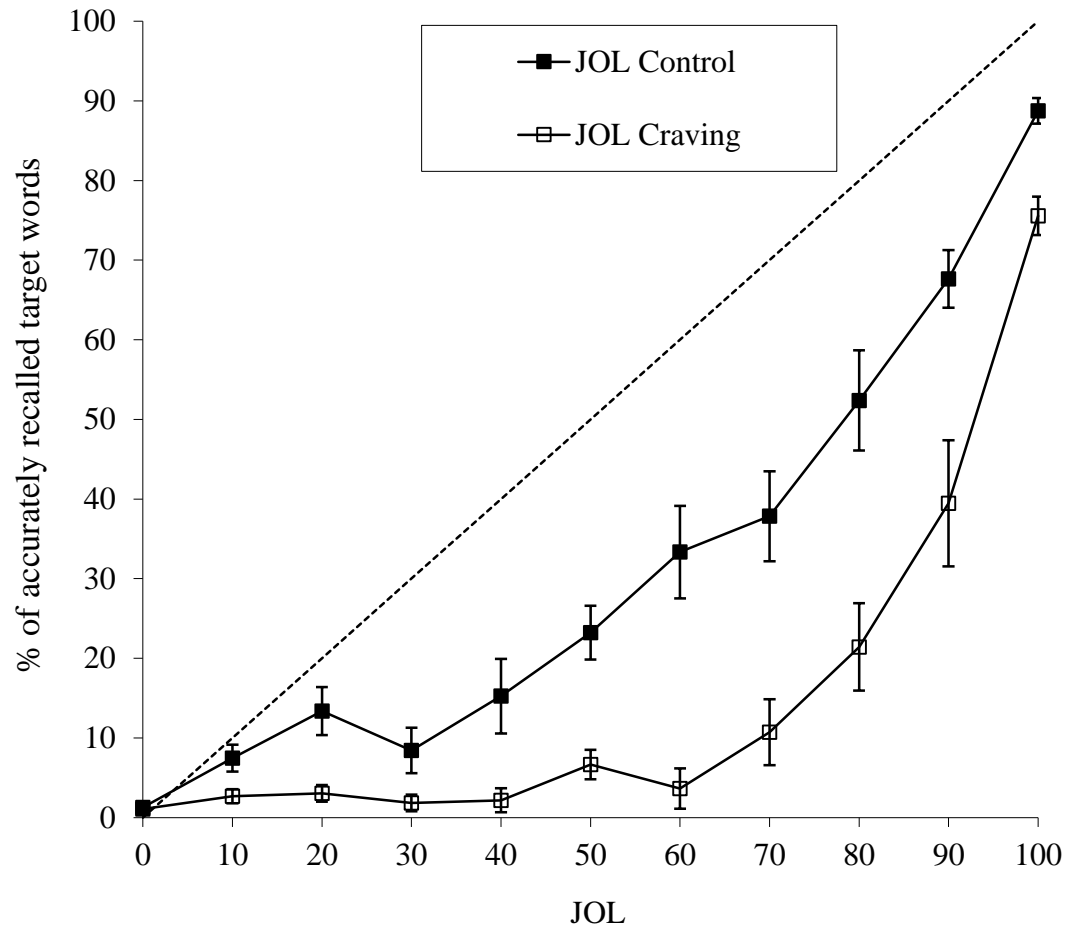


Figure 6. Calibration curve plotting JOL against the percentage of words accurately recalled for controls and cravers.

An independent-samples t-test compared controls' and cravers' level of correspondence between JOL ratings and overall recall accuracy. There was no significant difference in correspondence between JOL ratings and overall accuracy between controls ($M = .04$; $SD = .05$) and cravers ($M = .06$; $SD = .06$), $t(65) = -1.94$, $p = .056$, 95%CI $[-.05, .00]$, $d = .48$. This indicated that JOLs were equally as realistic for controls cravers

Over/Under confidence. O/U averages the amount of over or under confidence across all trials. For overconfidence to occur one's average JOL would need to be higher than their overall recall accuracy. For under confidence to occur one's

average confidence would need to be lower than their overall recall accuracy. Like calibration O/U functions via a range, namely -1 to 1. Within this range -1 equates to total under confidence (100% recall accuracy, with 0% confidence) and 1 equates to total over confidence (0% recall accuracy, with 100% confidence). Algebraically, O/U is calculated via the function: $\bar{p} - \bar{e}$ where \bar{p} equals one's mean level of confidence and \bar{e} equalling one's mean recall accuracy (Yang, Thompson, & Bland, 2012).

An independent-samples t-test compared controls' and cravers' level of O/U in terms of their overall recall accuracy. There was no significant difference in O/U between controls ($M = .07$; $SD = .11$) and cravers ($M = .11$; $SD = .13$), $t(65) = -1.33$, $p = .187$, 95% CI $[-.10, .02]$, $d = 0.33$. While inspection of Figure 6 appeared to show a clear difference in the level of overconfidence between controls and cravers, these results indicate that this difference is non-significant.

Resolution. Resolution corresponds to how able JOLs are at predicting subsequent recall accuracy (Yaniv, Yates, & Smith, 1991). Like calibration and O/U resolution utilises a coefficient in the form of the Adjusted Normalised Resolution Index (ANRI) statistic. This statistic functions via a numerical range of 0-1 where 0 equates to a complete inability for one to predict subsequent recall accuracy using one's knowledge of confidence and 1 equating to a perfect ability for one to predict subsequent recall accuracy using one's knowledge of confidence (Sauer, Weber, & Brewer, 2012). ANRI is calculated using the formula below and reflects the extent to which correct responses receive higher JOL ratings (Brewer & Wells, 2006):

$$ANRI = \frac{\left(n \left(\left[\frac{1}{n} \sum_{j=1}^J n_j (a_j - a)^2 \right] \div a(1 - a) \right) - j + 1 \right)}{n - j + 1}$$

An independent-samples t-test compared controls' and cravers' resolution via ANRI. There was no significant difference in the extent to which correct responses received higher JOL ratings between controls ($M = .57$; $SD = .27$) and cravers ($M = .54$; $SD = .28$), $t(62) = .36$, $p = .719$, 95%CI $[-.11, .16]$, $d = 0.09$. This result alongside the results of calibration and O/U appear to indicate that coffee cravings statistically did not influence JOL accuracy. One caveat to this is the effect size for calibration which was bordering on moderate. By looking at the calibration curve it appears that this task was quite difficult especially when JOL ratings were below chance. Due to the floor effect one may argue that the reason for near significance in terms of calibration is due to a significant difference in O/U. A conservative approach would be to re-run the analyses for calibration, O/U and resolution removing JOL estimates that were below chance. This would allow greater precision in determining any influence of the craving manipulation upon JOL accuracy.

Calibration (50% JOLs or above). Calibration was reanalysed using only JOLs of 50% and over. An independent-samples t-test on the updated calibration data resulted in a significant difference between JOLs and overall accuracy with controls ($M = .12$; $SD = .12$) being significantly better calibrated compared to cravers ($M = .19$; $SD = .15$), $t(65) = -2.09$, $p = .021$, 95%CI $[-.14, .00]$, $d = 0.52$. This indicated that JOLs were more realistic for those in the control group compared to cravers (see Figure 7.).

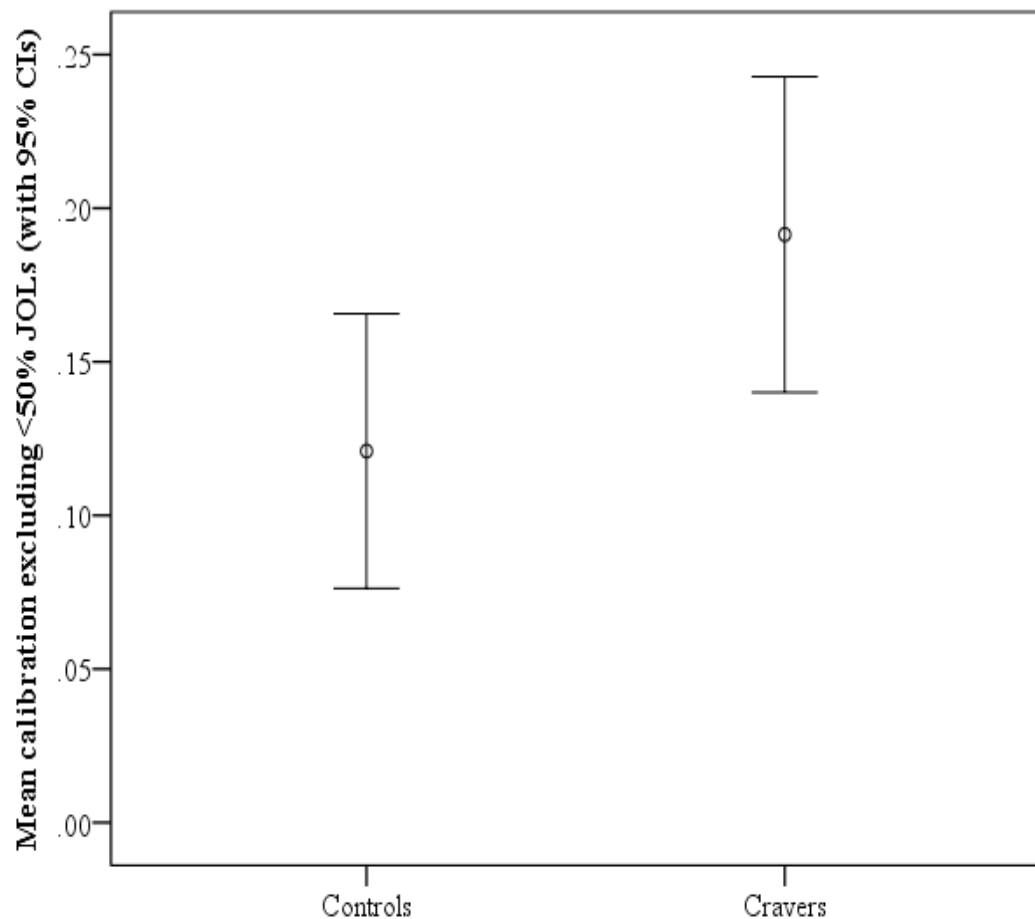


Figure 7. Calibration curve plotting JOL confidence greater than 50% against the percentage of words accurately recalled for controls and cravers.

O/U (50% JOLs or above). An independent samples t-test compared controls and cravers level of O/U in terms of their overall accuracy. There was no significant difference in O/U between controls ($M = .20$; $SD = .20$) and cravers ($M = .31$; $SD = .26$), $t(65) = -1.90$, $p = .062$, 95%CI $[-.22, .01]$, $d = 0.47$.

Resolution (50% JOLs or above). An independent-samples t-test compared controls and cravers resolution via ANRI. There was no significant difference in the extent to which correct responses received higher JOL ratings between controls ($M = .40$; $SD = .36$) and cravers ($M = .34$; $SD = .35$), $t(57) = .61$, $p = .543$, 95%CI $[-.13, .24]$, $d = 0.16$.

Discussion

Three outcomes were derived from the current study, two of which were clear and were expected and one that may require further investigation. The current study successfully induced coffee cravings via the use of enforced abstinence, in vivo exposure and imagery, which adds support to the notion that cravings, specifically coffee cravings, can be induced in an experimental context and supporting the first hypothesis (Kemps & Tiggemann, 2009a; 2009b; Tiggemann, Kemps, & Parnell, 2010). Secondly, controls accurately recalled significantly more words than cravers when the criterion included all responses (i.e. blank responses) on the word pair memory task (Koriat & Goldsmith, 1996). This, with the success of the craving manipulation indicates that cravings impaired cognitive performance supporting the second hypothesis as well as adding support to previous research. Finally, JOL calibration indicated that controls were significantly better calibrated than cravers. This final result indicates that the craving manipulation may have affected JOL accuracy in terms of calibration and adds tentative support to the theory that cravings may influence metacognitive accuracy.

Recall accuracy

The same principles highlighted by Koriat and Goldsmith, (1996) were employed in the current study to determine if quantity and accuracy based measures differed. When comparing total recall accuracy (quantity based) controls accurately recalled significantly more words than cravers. When comparing recall accuracy of only volunteered responses (accuracy based) no significant difference was found between controls and cravers, although a moderate effect size was found. The results appear to provide evidence that cravers suffered reduced performance in a cognitive task – in this case recall due to resources being allocated to the presence of cravings.

This result matches those of previous studies looking at cognitive resource utilisation when completing a basic cognitive task in the presence of induced cravings (Kemps, Tiggemann, & Grigg, 2008; Kemps & Tiggemann, 2009a; 2009b).

Did cravings influence JOL accuracy?

The results of the first calibration analysis indicated no significant difference in how realistic JOLs were between controls and cravers. In both conditions overconfidence was present (i.e. participants thought they would accurately recall more words than what they actually did) with cravers appearing to have higher overconfidence compared to controls based on visual inspection of the calibration curves. However, the results of the first O/U analysis indicated no significant difference between controls and cravers in terms of either over or under confidence.

Within the current study considerable overconfidence was found for both cravers and controls indicating that task difficulty may have been quite high which may help to explain the low accuracy rates in comparison to JOLs (i.e. calibration) (Son & Metcalfe, 2005). The presence of overconfidence in comparison to low accuracy may also be attributed to the way in which mnemonic cues were formed and under what conditions (Koriat, 1997). While calibration was non-significant in the first analysis, the presence of a moderate effect size indicated that craver's mnemonic cues may have been influenced by cravings resulting in poor accuracy and calibration. This could be due to mnemonic cues functioning beneath consciousness (Koriat, 2007). Interestingly there was also a considerable floor effect for cravers in that until around 60% confidence the percentage of words recalled accurately was around 5%. Due to the presence of a floor effect within the craving condition and no significant difference between controls and cravers in terms of over or under confidence a second calibration analysis was conducted.

The resolution results (i.e., extent to which correct responses receive higher JOL ratings) indicated that there was no significant difference between controls and cravers in their ability to discriminate between items that would and would not be recalled in a later test. ANRI values for both groups were average indicating some ability in using JOLs to predict performance, but no effect of craving on resolution. Thus it would appear that both groups' resolution was average indicating that cravers' mnemonic cues may have been largely unaffected by cravings.

The second calibration analysis indicated a significant difference in that controls were significantly better calibrated compared to cravers (i.e. the correlation between JOLs and predictive accuracy was significantly higher for controls than what it was for cravers). Once the floor effect was removed from the calibration curve it appeared that the difference in calibration may have been due to an apparent difference in O/U. This resulted in O/U being reanalysed using JOLs that were above chance level. The re-analysis of O/U indicated no significant difference, although a borderline effect size was found for O/U so it should not be discounted that cravers may have been more overconfident compared to controls. The second resolution analysis using the same exclusion criteria as the reanalysis for calibration and O/U was non-significant, although, the mean resolution dropped from .54 to .34 for cravers when only JOLs of 50% or more were used. This may indicate that cravings reduced the utility of mnemonic cues in terms of resolution i.e., when JOLs of 50% or more are used it would be expected that resolution would be higher compared to when all JOL ratings are used (Brewer & Wells, 2006). These results suggest that when participants make JOLs that are around chance level those who may be craving appear to be less well calibrated compared to controls although this difference may be in some way explained by the difference in overconfidence.

What does this all mean?

The pattern of current findings indicate that the impairment in cognition due to cravings resulted in a significant decrease in JOL calibration for cravers and a near significant difference in O/U where cravers appeared to be more overconfident compared to controls. Two possible outcomes from these results can be drawn.

Firstly, that the metacognitive processes of JOLs appears to be largely automatic and heuristically driven as craving participants were unable to moderate their JOLs due to the presence of another cognitive task requiring resources - reducing the likelihood of accurate target recall. This indicates that cravings may subvert the predictive utility and subsequent accuracy of JOLs in terms of recall accuracy (Koriat, 1997; 2007). This is important due to the supposed automatic nature of JOLs in that people may not be aware that cravings may be reducing the predictive utility of JOLs, possibly leading to serious consequences in terms judging one's own learning (Dunlosky & Metcalfe, 2009).

Secondly, it could be argued that due to JOLs being effected by the depletion in cognitive resources JOLs may be more deliberative than previously considered (Koriat, 1997). As JOLs appeared to be affected it may suggest that there is analytical component as JOLs may have been sensitive to the reduction in available resources, compared to if JOLs were purely heuristically driven and automatic. If JOLs are purely automatic and have such little analytical processing one may assume that JOLs would then be immune to the reduction in resources, i.e., cravings wouldn't influence JOLs as they may be immune from the dearth of resources.

Applying the results to theory

Koriat's (1997) cue-utilisation theory suggests that participants utilise cues when making JOLs and the accuracy of JOLs then depends on the correlation

between intrinsic, extrinsic and mnemonic cues used and the criteria of any subsequent memory test. If the assumption that delayed JOLs have an increased reliance on mnemonic cues is true, then it would appear that Koriat's (1997) experienced-based monitoring paradigm may be better suited in explaining delayed JOLs operation. Findings from the current study appear to support this idea in that cravers may have utilised these heuristics although the effect of craving may have reduced their utility.

Interestingly, Koriat (1993) suggested that the subjective instance of intuition, in terms of feeling that one knows the answer (which requires conscious awareness) is actually the end product which is the summation of processes or heuristics that operate beneath one's conscious awareness. This approach may explain why JOL calibration was significantly lower for cravers compared to controls; conscious awareness was not paid to the influence of cravings when making JOLs due to heuristics informing mnemonic cues operating beneath consciousness (Koriat, 2007; Metcalfe & Finn, 2008; Son & Metcalfe, 2005).

Research indicates that JOLs are permeable to the ease in which information is processed and that JOLs reflect the likelihood of future recall, but also other factors like the difficulty in which to-be-remembered words are retrieved during the learning process (Begg, Duft, Lalonde, Melnick, & Sanvito, 1989; Benjamin, Bjork, and Schwartz, 1998; Koriat, 1997; 2007). As these factors are suggested to function beneath one's conscious awareness it is plausible that they permeated JOLs – the question then becomes whether the cues were accurate (not effected by cravings) or inaccurate (effected by cravings). But this distinction may not be so straightforward in that cues that were affected by cravings which affected future recall performance may actually have been accurate in the end. One solution may be to inspect the

response times to determine how quickly items were encoded and retrieved which may help elucidate cue accuracy in terms of JOLs (Metcalf & Finn, 2008; Son and Metcalfe, 2005).

What does this mean in terms of cravings? In terms of calibration including only JOLs greater than 50%, controls were significantly more realistic compared to cravers in their JOL accuracy (ability to successfully judge the likelihood of target recall). One explanation for this finding surrounds how mnemonic cues function in terms of resource utilisation. Craving literature suggests that regions synonymous with working memory and cognitive control are heavily utilised in the presence of cravings and that cravings in general shift cognitive resources to attending to that craving (Englemann, 2012; Tiffany, 1990; 1995). The question then becomes, can mnemonic cues, such as encoding fluency and information retrieval be permeable to cravings resulting in an inaccurate metacognitive judgement?

The calibration evidence indicates that participants in the craving condition may have indirectly suffered from encoding fluency and/or information retrieval issues due to the presence of cravings thus leading to reduced calibration (Metcalf & Finn, 2008; Son & Metcalfe, 2005). This explanation does have some credence following Koriat's (1997) experience-based paradigm as the mnemonic cues are suggested to function beneath one's consciousness, this may explain why cravers were overconfident in their ability but subsequently recalled significantly less words compared to controls i.e., they may have been unaware of the impact upon these cues (Metcalf & Finn, 2008; Koriat, 1993; 1997; 2006). Evidence for this suggestion can also be seen in the levels of overconfidence, while not being statistically significant the borderline effect size indicates cravers exhibited greater overconfidence.

Due to mnemonic cues influencing metacognitive judgements JOLs may have been overstated in the craving condition (Koriat & Goldsmith, 1996). Cravers may not have been aware that mnemonic cues such as processing fluency and retrieval ability may have been negatively affected due to cognitive resources being utilised by the presence of cravings (Zuj, Palmer, & Kemps, 2015). This may explain why cravers were so poor in terms of calibration compared to controls.

Limitations

The use of imagery and in vivo exposure was combined in the current study due to the associated strength in combining both visual and imagery methods of craving (Kemps & Tiggemann, 2009a; 2009b; Tiffany, Carter, & Singleton, 2000). Due to this combination we were unable to ascertain if one method was stronger in its ability to induce cravings. The current study also did not utilise a baseline measure of imagery ability which was used by Kemps & Tiggemann, (2009a; 2009b). Future studies would be advised to incorporate a baseline imagery ability measure to control for participants low on imagery.

In terms of caffeine, research has proposed that the half-life of caffeine may be as much as doubled in women who consume oral contraceptive and as little as half in smokers (Kalow, 1985). If participants were smokers they may have entered caffeine withdrawal, invalidating the measure of coffee craving as they may have been craving the secondary effects of coffee i.e., caffeine (Juliano & Griffiths, 2004). Screening for smoking status or oral contraceptive use may have resulted in greater confidence that coffee craving was being measured compared to symptoms of withdrawal.

Summary

In conclusion, a successful craving induction resulted in significantly higher craving ratings across four time points compared to controls. In turn, craving participants accurately recalled significantly less words compared to controls. There was no significant difference between cravers and controls in terms of over or under confidence, resolution or calibration although a moderate effect size was found for calibration. Due to the resulting effect size and an identified floor effect in terms of cravers' accuracy a conservative approach was taken which compared calibration between controls and cravers when JOL ratings were at chance level or above. This resulted in controls being significantly better calibrated to cravers.

In terms of the experience-based paradigm this result suggests mnemonic cues such as encoding fluency and information retrieval ability may require cognitive resources as intrinsic and extrinsic cues were largely controlled (i.e., word pairs were unrelated and presented only once) although encoding was self-paced. Due to the fact that these mnemonic cues function beneath consciousness participants experiencing cravings may have used these cues unbeknownst that the mnemonic cues may have been violated by the presence of cravings reducing their utility in JOL formation. Determining whether JOLs are automatic or deliberative cannot be answered with confidence within this study, although arguments for both are made.

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Appendix A

Ethics Approval Form

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 1832
Fax: (03) 6226 7148
Human.ethics@utas.edu.au



HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

01 May 2015

Dr Matt Palmer
Psychology
Private Bag 1342

Sent via email

Dear Dr Palmer

Re: APPROVAL FOR AMENDMENT TO CURRENT PROJECT
Ethics Ref: H0012507 - The Effect of Caffeine Cravings on Cognitive Performance in a Mock-Juror Sample

Amendments:

- The addition of Angus Ling and Josh Riza as student investigators (Honours in Psychology).
- The addition of Jim Sauer as an investigator.
- The use of updated stimulus materials.

We are pleased to advise that the Chair of the Tasmania Social Sciences Human Research Ethics Committee approved the Amendment to the above project on 29/4/2015.

Yours Sincerely

Natasha Jones
Ethics Officer
Tasmanian Social Sciences HREC

Appendix B

Example email sent to cravers

EXAMPLE

Reminder Email Regarding Your Participation in the Coffee and Cognition Study

Hello,

Just a quick email to remind you that you are scheduled to participate in our study on Wednesday the 26th of August from 1:00 PM to 2:00 PM. The study is being held in room 103 in the psychology research building but **we will meet you in the psychology foyer area on the ground floor of the social sciences building at 1:00 PM.**

Please note that you must be a regular coffee drinker (at least one cup per day) to participate in this study.

PLEASE DO NOT CONSUME ANY COFFEE ON THE DAY OF YOUR APPOINTMENT

You will be reimbursed for your time. If you are **not a first year psychology student**, or you **are a first year psychology student who has fulfilled course credit requirements** you will be paid \$20 in the form of a Coles/Myer voucher.

If you are a **first year psychology student who has not fulfilled your course credit requirements** you will receive **90 minutes of course credit**.

If you have any further questions, you can email either Angus or myself or ask us at your appointment on Wednesday.

If you need to cancel or reschedule the appointment, please notify either Angus or myself ASAP so that we can reschedule (if applicable).

Thank you,
Angus Ling & Joshua Riza

Appendix C

Example email sent to controls

EXAMPLE

Reminder Email Regarding Your Participation in the Coffee and Cognition Study

Hello,

Just a quick email to remind you that you are scheduled to participate in our study on Wednesday the 26th of August from 1:00 PM to 2:00 PM. The study is being held in room 103 in the psychology research building but **we will meet you in the psychology foyer area on the ground floor of the social sciences building at 1:00 PM.**

Please note that you must be a regular coffee drinker (at least one cup per day) to participate in this study.

Continue coffee consumption as you normally would

You will be reimbursed for your time. If you are **not a first year psychology student**, or you **are a first year psychology student who has fulfilled course credit requirements** you will be paid \$20 in the form of a Coles/Myer voucher.

If you are a **first year psychology student who has not fulfilled your course credit requirements** you will receive **90 minutes of course credit**.

If you have any further questions, you can email either Angus or myself or ask us at your appointment on Wednesday.

If you need to cancel or reschedule the appointment, please notify either Angus or myself ASAP so that we can reschedule (if applicable).

Thank you,
Angus Ling & Joshua Riza



Appendix D

Information Form for Cravers

Locked Bag 1342 Launceston Tasmania 7250 Australia Phone (03) 6324 3004 Fax (03) 6324 3168 matthew.palmer@utas.edu.au	
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Factors that influence thinking and decision making

Information Sheet for Participants

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1. Invitation

You are invited to participate in a research study examining factors that affect cognitive performance. Cognitive performance refers to an individual's ability to perform processes such as attention, memory, perception and problem solving. The study is being conducted by Angus Ling and Josh Riza, who are completing Honours in Psychology, and Dr Matthew Palmer and Dr Jim Sauer of the Division of Psychology.

2. What is the purpose of this study?

The purpose of the study is to enhance our understanding of the factors which influence cognitive performance and the ability to make accurate decisions.

3. Why have I been invited to participate?

For this experiment, we are looking for people aged 17 years or more.

Your participation would contribute to research and understanding in this area. Participation in this study is voluntary – you are entirely free to choose to participate or not, and there will be no consequences if you decide not to participate. If you do participate, any information you provide will be anonymous and no participants in the experiment will be individually identifiable.

4. What will I be asked to do?

Participation would require approximately 60 minutes of your time on only one occasion and would take place in a room in the Psychology building on the UTAS campus. The study involves reading pairs of words and answering some questions about them. Additionally, participants will be asked to complete some brief questionnaires on issues relating to factors which may impair cognitive performance. The tasks will take approximately 60 minutes to complete in total.

In addition, you would be asked to avoid consuming any caffeine on the day of the study until you have finished participating in the study (i.e., no coffee, no energy drinks, no caffeine tablets, etc.)

5. Are there any possible benefits from participation in this study?

We do not expect that the study will directly benefit participants. However, there may be benefits for the wider community. If we are able to determine whether something impairs cognitive performance our findings will have a number of implications for any real world circumstances in which optimal cognitive performance is required. For example, our findings may help in maximizing workplace productivity or in improving people's ability to make accurate decisions. This research may lead to a better understanding of the area of cognitive performance, as well as broadening your knowledge of scientific experimentation.



Locked Bag 1342 Launceston

Tasmania 7250 Australia

Phone (03) 6324 3004 Fax (03) 6324 3168

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6. Are there any possible risks from participation in this study?

There are no specific risks anticipated with participation in this study. However, if you find that you are becoming distressed or fatigued you can discontinue the task at any time. Additionally, you will be provided with support from the experimenters or, alternatively, we will arrange for you to see a counsellor at no expense.

7. What if I change my mind during or after the study?

That's fine - you are free to withdraw from the study at any time, and without providing an explanation. If you choose to withdraw during the study, your responses will be destroyed. If you complete the study, you will not be able to withdraw your data because it will be stored in anonymous form (and so we will not be able to identify which responses are yours).

8. What will happen to the information when this study is over?

The data from this study will be kept in secure storage on the University of Tasmania premises for a period of five years after any publications (e.g., in academic journals) that involve the data. After this period, the data will be archived. Only the researchers will have access to the raw data. The data will be stored anonymously. All responses will be anonymous and no identifying information will be collected from participants.

9. How will the results of the study be published?

The results of the study will be published in an academic journal. Once the study has been completed, you will be able to access the results by visiting the website below:

<http://www.utas.edu.au/psychology/research/research-project-reports>

No individual participants will be identifiable in the publication of the results.

10. What if I have questions about this study?

If you would like to discuss any aspect of this study please feel free to contact us:

Angus Ling, (lingar@utas.edu.au) Josh Riza, (jlriza@utas.edu.au), Dr Matthew Palmer (matthew.palmer@utas.edu.au) or Dr Jim Sauer (jim.sauer@utas.edu.au). We would be happy to discuss any aspect of the research with you. Once the information has been analyzed a summary of the findings may be obtained on request. You are welcome to contact us at that time to discuss any issue relating to the research study.

Thank you for taking the time to consider this study.

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number H12507.

This information sheet is for you to keep. If you would like to participate in this study, please ask the researcher for a Consent Form to complete.



Appendix E

Information Form for Controls

Locked Bag 1342 Launceston

Tasmania 7250 Australia

Phone (03) 6324 3004 Fax (03) 6324 3168

matthew.palmer@utas.edu.au



Factors that influence thinking and decision making

Information Sheet for Participants

1. Invitation

You are invited to participate in a research study examining factors that affect cognitive performance. Cognitive performance refers to an individual's ability to perform processes such as attention, memory, perception and problem solving. The study is being conducted by Angus Ling and Josh Riza, who are completing Honours in Psychology, and Dr Matthew Palmer and Dr Jim Sauer of the Division of Psychology.

2. What is the purpose of this study?

The purpose of the study is to enhance our understanding of the factors which influence cognitive performance and the ability to make accurate decisions.

3. Why have I been invited to participate?

For this experiment, we are looking for people aged 17 years or more.

Your participation would contribute to research and understanding in this area. Participation in this study is voluntary – you are entirely free to choose to participate or not, and there will be no consequences if you decide not to participate. If you do participate, any information you provide will be anonymous and no participants in the experiment will be individually identifiable.

4. What will I be asked to do?

Participation would require approximately 60 minutes of your time on only one occasion and would take place in a room in the Psychology building on the UTAS campus. The study involves reading pairs of words and answering some questions about them. Additionally, participants will be asked to complete some brief questionnaires on issues relating to factors which may impair cognitive performance. The tasks will take approximately 60 minutes to complete in total.

5. Are there any possible benefits from participation in this study?

We do not expect that the study will directly benefit participants. However, there may be benefits for the wider community. If we are able to determine whether something impairs cognitive performance our findings will have a number of implications for any real world circumstances in which optimal cognitive performance is required. For example, our findings may help in maximizing workplace productivity or in improving people's ability to make accurate decisions. This research may lead to a better understanding of the area of cognitive performance, as well as broadening your knowledge of scientific experimentation.

6. Are there any possible risks from participation in this study?

There are no specific risks anticipated with participation in this study. However, if you find that you are becoming distressed or fatigued you can discontinue the task at any time.



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Additionally, you will be provided with support from the experimenters or, alternatively, we will arrange for you to see a counsellor at no expense.

7. What if I change my mind during or after the study?

That's fine - you are free to withdraw from the study at any time, and without providing an explanation. If you choose to withdraw during the study, your responses will be destroyed. If you complete the study, you will not be able to withdraw your data because it will be stored in anonymous form (and so we will not be able to identify which responses are yours).

8. What will happen to the information when this study is over?

The data from this study will be kept in secure storage on the University of Tasmania premises for a period of five years after any publications (e.g., in academic journals) that involve the data. After this period, the data will be archived. Only the researchers will have access to the raw data. The data will be stored anonymously. All responses will be anonymous and no identifying information will be collected from participants.

9. How will the results of the study be published?

The results of the study will be published in an academic journal. Once the study has been completed, you will be able to access the results by visiting the website below:

<http://www.utas.edu.au/psychology/research/research-project-reports>

No individual participants will be identifiable in the publication of the results.

10. What if I have questions about this study?

If you would like to discuss any aspect of this study please feel free to contact us:

Angus Ling, (lingar@utas.edu.au) Josh Riza, (jlriza@utas.edu.au), Dr Matthew Palmer (matthew.palmer@utas.edu.au) or Dr Jim Sauer (jim.sauer@utas.edu.au). We would be happy to discuss any aspect of the research with you. Once the information has been analyzed a summary of the findings may be obtained on request. You are welcome to contact us at that time to discuss any issue relating to the research study.

Thank you for taking the time to consider this study.

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number H12507.

This information sheet is for you to keep. If you would like to participate in this study, please ask the researcher for a Consent Form to complete.



Appendix F

Consent form

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Factors that influence thinking and decision making

Participant Consent Form

1. I agree to take part in the research study named above.
2. I have read and understood the Information Sheet for this study.
3. The nature and possible effects of the study have been explained to me.
4. I understand that the study involves participating in a decision making task in which I will study word pairs and answer some questions about them. Additionally, I understand that the researcher will ask me to complete some brief questionnaires. These tasks will take approximately 60 minutes total to complete in total.
5. I understand that participation involves no foreseeable risks.
6. I understand that all research data will be securely stored on the University of Tasmania premises for five years from the publication of the study results, and will then be destroyed unless I give permission for my data to be archived.
I agree to have my study data archived. (Note that your data will be stored anonymously.)
Yes ☐ No ☐
7. Any questions that I have asked have been answered to my satisfaction.
8. I understand that the researchers will maintain confidentiality and that any information I supply to the researcher will be used only for the purposes of the research.
9. I understand that the results of the study will be published so that I cannot be identified as a participant.
10. I understand that my participation is voluntary and that I may withdraw at any time without any effect.
I understand that I will not be able to withdraw my data after completing the experiment as my data will be anonymous.

Participant's name: _____

Participant's signature: _____

Date: _____

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Tasmania 7250 Australia

Phone (03) 6324 3004 Fax (03) 6324 3168

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Statement by Investigator

☐

I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

☐

The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Investigator's name: _____

Investigator's signature: _____

Date: _____

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Appendix G

Descriptive Information Form

Participant ID: _____

Descriptive Information

Tick appropriate boxes if they apply, if they do not apply to you then leave them blank.

Sex

- | | |
|---|--|
| <input type="checkbox"/> Male | <input type="checkbox"/> Female |
| <input type="checkbox"/> I do not identify as either male or female. I identify as: _____ | <input type="checkbox"/> Prefer not to say |

Age

- ☐ Please enter your age: _____

Coffee consumption per day on average (*one serving equals 250ml or a regular latte/flat white/long or short black*)

- | | |
|---------------------------------------|--|
| <input type="checkbox"/> One serving | <input type="checkbox"/> Three servings |
| <input type="checkbox"/> Two servings | <input type="checkbox"/> Four or more servings |

Have you consumed any other caffeinated substances in the last 24 hours such as tea, or energy drinks/supplements?

- ☐ Yes ☐ No

☐ What were they? _____

Time since you last ingested coffee?

- | | | |
|---|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> Less than one hour ago | <input type="checkbox"/> 10-12 hours | <input type="checkbox"/> 22-24 hours |
| <input type="checkbox"/> 1-2 hours | <input type="checkbox"/> 12-14 hours | <input type="checkbox"/> 24-30 hours |
| <input type="checkbox"/> 2-4 hours | <input type="checkbox"/> 14-16 hours | <input type="checkbox"/> 30-36 hours |
| <input type="checkbox"/> 4-6 hours | <input type="checkbox"/> 16-18 hours | <input type="checkbox"/> 36-42 hours |
| <input type="checkbox"/> 6-8 hours | <input type="checkbox"/> 18-20 hours | <input type="checkbox"/> 42-48 hours |
| <input type="checkbox"/> 8-10 hours | <input type="checkbox"/> 20-22 hours | <input type="checkbox"/> 48+ hours |

Are you a first year psychology undergraduate student?

- ☐ Yes ☐ No
- ☐ Prefer not to say

Appendix H

Verbalised Imagery Task for Controls

I want you to walk up to the table and to pick up the jug of water and pour yourself a cup. Now proceed to hold the cup as you normally would. As you do this, focus on your favourite holiday [PAUSE].

Imagine what it would be like to be on this holiday right at this moment. Keep imagining this until I speak again [PAUSE].

Now pay attention to the smells and sounds of the holiday [PAUSE]. Imagine again what it would be like to be on your favourite holiday right at this moment. Pay attention to the sounds you would hear on this holiday [PAUSE]. Keep focusing on the sights and sounds of holiday until I speak again.

Now stand with your cup of water and walk over to the table where you poured yourself a cup and place your cup on that same table. As you do so, imagine for the last time, what it would be like to be on your favourite holiday [PAUSE].

You have now completed this part of the experiment.

Appendix I

Verbalised Imagery Task for Cravers

On the table, you will see a hot jug of freshly made coffee and an empty white mug.

Take a moment to look at these objects [PAUSE].

Now, I want you to walk up to the table and to pick up the jug of freshly made coffee and pour yourself a cup and to pay attention to the sound of the coffee being poured into the cup. Now proceed to hold the cup of coffee as you normally would. As you do this, focus on the weight in the cup now that it is full [PAUSE]. Imagine what it would be like to drink a cup of your favourite coffee right at this moment. Keep imagining this until I speak again. [PAUSE]

Now sit down in the chair with your cup of coffee and pay attention to the smell of the coffee and the colour and imagine again what it would be like to have a cup of your favourite coffee right at this moment [PAUSE]. Pay attention to any steam as it slowly curls and rises above the cup. Keep focussing on the sight and smell of the cup of coffee until I speak again.

Now stand with your cup of coffee and walk over to the table where you poured yourself a cup and place your cup on that same table. As you do so, imagine for the last time, what it would be like to drink a cup of your favourite coffee. [PAUSE]

You have now completed this component of the project.

Appendix J

Retrospective Visual Analogue Scale measuring craving strength

Craving Intensity Scale

1. When you first arrived here (before testing began), how strong was your desire for coffee?

Please draw a vertical mark on the line below

0	-----	100
No		Extremely
desire		strong
		desire

2. Immediately after the first induction task (where you imagined a scenario), how strong was your desire for coffee?

Please draw a vertical mark on the line below

0	-----	100
No		Extremely
desire		strong
		desire

3. Immediately after the second induction task (where you imagined a scenario), how strong was your desire for coffee?

Please draw a vertical mark on the line below

0	-----	100
No		Extremely
desire		strong
		desire

4. Right now, how strong is your desire for coffee drink?

Please draw a vertical mark on the line below

0	-----	100
No		Extremely
desire		strong
		desire

Appendix K

Attitudes to Caffeine Questionnaire (ACQ)

Attitudes to Caffeine Questionnaire

Instructions: Circle the extent to which each item describes you, from 1 to 7, using:

1: Not at all like me

2: Quite like me

3: Not much like me

4: Neutral

5: Somewhat like me

6: Quite like me

7: Very much like me

1. I consume caffeine/coffee to cheer me up when I am down.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

2. I often consume caffeine/coffee when I am bored.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

3. I consume more caffeine/coffee than is good for me.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

4. I never crave caffeine/coffee.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

5. My desire for caffeine/coffee often seems overpowering.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

6. The thought of caffeine/coffee often distracts me from what I am doing (e.g. watching TV).

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7. I usually find myself wanting caffeine/coffee during the morning.

1	2	3	4	5	6	7
---	---	---	---	---	---	---



- 1: Not at all like me
 2: Quite like me
 3: Not much like me
 4: Neutral
 5: Somewhat like me
 6: Quite like me
 7: Very much like me

8. If I crave caffeine/coffee I can't get it out of my head until I drink some.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

9. I often go to the shop for something else and end up buying caffeine/coffee.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

10. Caffeine/coffee often preys on my mind.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

11. When I am upset caffeine/coffee comforts me.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

12. I would describe my craving for caffeine/coffee as more intense than a simple desire or longing.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

13. Nothing but caffeine/coffee will satisfy my caffeine/coffee cravings.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

14. Even when I do not really want anymore I will carry on drinking caffeine/coffee.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

15. I like the taste of caffeine/coffee.

1	2	3	4	5	6	7
---	---	---	---	---	---	---



Appendix L

Caffeine Dependence Questionnaire (CDQ)

Caffeine Dependence Questionnaire

Instructions: While answering this questionnaire:

- Think about the last week and circle the answer most appropriate to you
- Think about the caffeinated beverages you consume most frequently
- Please circle the answer that is most appropriate to you

- 1 Do you find yourself thinking about when you will next be able to have another caffeinated beverage?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------
- 2 Is consuming caffeine more important than anything else you might do during the day?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------
- 3 Do you feel your need for caffeine is too strong to control?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------
- 4 Do you plan your days around getting and consuming caffeine?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------
- 5 Do you drink caffeinated beverages in a particular way in order to increase the effect it gives you?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------
- 6 Do you drink caffeinated beverages morning, afternoon, and evening?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------
- 7 Do you feel you have to carry on drinking caffeinated beverages once you have started?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------
- 8 Do you want to consume more caffeinated beverages when the effect starts to wear off?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------
- 9 Is getting the effect you want (i.e. increased energy/alertness) more important than the particular caffeinated beverage you use?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------
- 10 Do you find it difficult to cope with life without caffeine?

Never	Sometimes	Often	Nearly always
-------	-----------	-------	---------------

Appendix M

Debrief form

Participant Debriefing Information Sheet Social Science/Humanities Research

Explanation of the experiment: The role of caffeine and cravings

Thank you for participating in this study. Your participation is invaluable and will contribute to the research and understanding in this area. As you may have noticed, the study was actually examining the effect of caffeine cravings (the intense urge or desire to consume a specific substance, in this case, caffeine) on cognition. Previous studies have found that cravings reduce the cognitive resources that people can dedicate to tasks. We are looking at the effects of caffeine cravings on metacognition. For example, do cravings influence how well you can predict whether you will be able to remember something in the future?

Why wasn't I told about the role of cravings for caffeine in this experiment?

In order to ensure this study is conducted effectively, we were unable to disclose all aspects of the study beforehand. Studies have found that if participants are aware that a study is looking at cravings beforehand, the control group (those who were not supposed to experience cravings) may unintentionally start to crave during the testing process. This would have confounded the results obtained by the study, and would have limited the utility of the study.

This study is entirely voluntary and confidential

It is important to understand that your involvement in the study is completely voluntary, and you may still withdraw at any time. If you are uncomfortable with having been deceived, you may request that any information you have provided so far be destroyed without consequence, and without providing an explanation for this. We would like to again remind you that all information will be treated in a confidential manner, and your name will not be used in any publication associated with the study. Any materials from the study will be kept secure by the University of Tasmania's psychology department.

If you would like, the experimenters can provide or arrange for support, at no cost to you.

What if I have questions about this research?

If you would like to further discuss any part of this study, please do not hesitate to contact us via email Angus Ling, (lingar@utas.edu.au) Josh Riza (jlriza@utas.edu.au), Dr Matthew Palmer (matthew.palmer@utas.edu.au) or Dr Jim Sauer (jim.sauer@utas.edu.au). Once results from the study have been finalised, a summary of findings from the study may be obtained on request.

This study has been approved by the Tasmanian Social Science Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, you are able to contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or via human.ethics@utas.edu.au. Please quote ethics reference number H0012507.

Thank you for taking the time to participate in this study.

This information sheet is for you to keep.

Appendix N

Input Modifications

Please see the associated zip file or the attached CD to view the word document that contains the modified changes that were moderated by two researchers.

Appendix O

SPSS Data

Please see the associated zip file or the attached CD to view the SPSS data output for analysis one and analysis two.

Appendix P

Words used

Please see the associated zip file or the attached CD to view the list of word pairs used within this study.